CLAIMS

What is claimed is:

1. An isolated nucleotide acid sequence or fragment thereof comprising or complementary to a nucleotide sequence encoding a polypeptide having desaturase activity, wherein the amino acid sequence of said polypeptide has at least 50% sequence identity to an amino acid sequence selected from the group consisting of SEQ ID NO:26 and SEQ ID NO:42.

2. An isolated nucleotide sequence or fragment thereof comprising or complementary to at least 50% of the nucleotide sequence selected from the group consisting of SEQ ID NO:25 and SEQ ID NO:41.

3. The isolated nucleotide sequence of claim 2, wherein said sequence is selected from the group consisting of SEQ ID NO:25 and SEQ ID NO:41.

4. The isolated nucleotide sequence of claim 2 or 3, wherein said sequence encodes a functionally active desaturase which utilizes a polyunsaturated fatty acid as a substrate.

5. The isolated nucleotide sequence of claim 1 or 2, wherein said sequence is derived from *Saprolegnia diclina*.

6. A purified polypeptide encoded by said isolated nucleotide sequence of claim 1 or 2.

7. A purified polypeptide that desaturates a polyunsaturated fatty acid substrate at an omega-3 carbon of said substrate and has at least 50% amino acid identity to an amino acid sequence comprising SEQ ID NO: 26.

8. The purified polypeptide of claim 7, wherein said

polypeptide desaturates a fatty acid substrate having 20 carbon atoms.

9. A purified polypeptide that desaturates a polyunsaturated fatty acid substrate at a delta-12 carbon of said substrate and has at least 50% amino acid identity to SEQ ID NO: 42.

10. The purified polypeptide of claim 9, wherein said polypeptide desaturates a fatty acid substrate having 18 carbon atoms.

11. A method of producing a desaturase comprising the steps of:

(a) isolating a nucleotide sequence comprising or complementary to at least 50% of the nucleotide sequence selected from the group consisting of SEQ ID NO: 25 and SEQ ID NO: 41;

(b) constructing a vector comprising said isolated nucleotide sequence of step (a); and

(c) introducing said vector of step (b) into a host cell for a time and under conditions sufficient for expression of a desaturase encoded by said isolated nucleotide sequence of step (a).

12. A vector comprising: 1) an isolated nucleotide sequence corresponding to or complementary to at least 50% of the nucleotide sequence selected from the group consisting of SEQ ID NO: 25 and SEQ ID NO: 41, operably linked to b) a regulatory sequence.

13. A host cell comprising said vector of claim 12.

14. The host cell of claim 13, wherein said host cell is a eukaryotic cell selected from the group consisting of a mammalian cell, an insect cell, a plant cell and a fungal cell.

15. The host cell of claim 14, wherein expression of said isolated nucleotide sequence of said vector results in said host cell producing a polyunsaturated fatty acid that is not produced in a wild-type of said host cell.

16. A plant cell, plant, or plant tissue comprising said vector of claim 12, wherein expression of said nucleotide sequence of said vector results in production of a polyunsaturated fatty acid by said plant cell, plant or plant tissue.

17. The plant cell, plant, or plant tissue of claim 16, wherein said vector induces the production of a polyunsaturated fatty acid selected from the group consisting of linoleic acid, eicosatetraenoic acid and eicosapentaenoic acid.

18. A transgenic plant comprising said vector of claim 12, wherein expression of said nucleotide sequence of said vector results in production of a polyunsaturated fatty acid in seeds of said transgenic plant.

19. One or more plant oils or acids expressed by said plant cell, plant or plant tissue of claim 16.

20. A method for producing a polyunsaturated fatty acid comprising the steps of:
(a) isolating a nucleotide sequence comprising or complementary to at least 50% of the nucleotide sequence selected from the group consisting of SEQ ID NO: 25 and SEQ ID NO: 41;
(b) constructing a vector comprising said isolated nucleotide sequence of step (a);
(c) transforming the vector of step (b) into a host cell for a time and under conditions sufficient for expression of a desaturase encoded by said isolated nucleotide sequence of step (a); and

(d) exposing said expressed desaturase selected from the group consisting of an omega-3-desaturase and a delta 12-desaturase, to a fatty acid substrate, whereby said substrate is catalytically converted by said desaturase into a desired polyunsaturated fatty acid product.

21. The method of claim 20, wherein said substrate is dihomo-gamma-linolenic acid or arachidonic acid and said product polyunsaturated fatty acid is eicosatetraenoic acid or eicosapentaenoic acid, respectively, when said expressed desaturase is an omega-3-desaturase.

22. The method of claim 20, wherein said substrate polyunsaturated fatty acid is oleic acid and said product polyunsaturated fatty acid is linoleic acid, when said expressed desaturase is a delta 12-desaturase.

23. The method of claim 20, further comprising, after step (d), the step of:
(e) exposing said polyunsaturated fatty acid product of step (d) to one or more enzymes selected from the group consisting of a desaturase and an elongase, whereby the polyunsaturated fatty acid product of step (d) is catalytically converted into another polyunsaturated fatty acid product.

24. The method of claim 23, wherein said product polyunsaturated fatty acid is eicosatetraenoic acid or eicosapentaenoic acid and said another polyunsaturated fatty acid is eicosapentaenoic acid or omega 3-docosapentaenoic acid, respectively, when said expressed desaturase of step (d) is an omega 3-desaturase.

25. The method of claim 23, wherein said product polyunsaturated fatty acid is linoleic acid and said another polyunsaturated fatty acid is gamma-linolenic acid, when said expressed desaturase of step (d) is a delta 12-desaturase.

26. The method of claim 23 further comprising the step of exposing said another polyunsaturated fatty acid to one or more enzymes selected from the group consisting of a desaturase and an elongase in order to convert said another polyunsaturated fatty acid to a final polyunsaturated fatty acid.

27. The method of claim 26 wherein said final polyunsaturated fatty acid is selected from the group consisting of omega 3-docosapentaenoic acid and docosahexaenoic acid, when said expressed desaturase of step (d) is an omega 3-desaturase.

28. The method of claim 26 wherein said final polyunsaturated fatty acid is selected from the group consisting of dihomo-gamma-linolenic acid, arachidonic acid, adrenic acid, omega 6-docosapentaenoic acid, eicosatetraenoic acid, stearidonic acid, eicosapentaenoic acid, omega 3-docosapentaenoic acid and docosahexaenoic acid, when said expressed desaturase of step (d) is a delta 12-desaturase.

29. A method of producing a polyunsaturated fatty acid comprising exposing a fatty acid substrate to a polypeptide having at least 50% amino acid identity to an amino acid sequence selected from the group consisting of SEQ ID NO: 26 and SEQ ID NO: 42, whereby said fatty acid substrate is catalytically converted into said polyunsaturated fatty acid.

30. The method of claim 29, wherein the fatty acid substrate is dihomo-gamma-linolenic acid or arachidonic acid and said product polyunsaturated fatty acid is eicosatetraenoic acid or eicosapentaenoic acid, respectively, when said polypeptide is an omega 3-desaturase.

31. The method of claim 29, wherein said fatty acid substrate is oleic acid and said polyunsaturated fatty acid is linoleic acid, when said polypeptide is a delta 12-desaturase.

32. A composition comprising at least one polyunsaturated fatty acid selected from the group consisting of said product polyunsaturated fatty acid produced according to the method of claim 20, said another polyunsaturated fatty acid produced according to the method of claim 23, and said final polyunsaturated fatty acid produced according to the method of claim 26.

33. The composition of claim 32, wherein said product polyunsaturated fatty acid is eicosatetraenoic acid or eicosapentaenoic acid, when said expressed desaturase of step (d) is an omega 3-desaturase.

34. The composition of claim 32, wherein said product polyunsaturated fatty acid is linoleic acid, when said expressed desaturase of step (d) is a delta 12-desaturase.

35. The composition of claim 32, wherein said another polyunsaturated fatty acid is eicosapentaenoic acid or omega 3-docosapentaenoic acid, respectively, when said expressed desaturase of step (d) is an omega 3-desaturase.

36. The composition of claim 32, wherein said another polyunsaturated fatty acid is gamma-linolenic acid, when said expressed desaturase of step (d) is a delta 12-desaturase.

37. The composition of claim 32, wherein said final polyunsaturated fatty acid is selected from the group consisting of omega 3-docosapentaenoic acid and docosahexaenoic acid, when said expressed desaturase of step (d) is an omega 3-desaturase.

38. The composition of claim 32, wherein said final polyunsaturated fatty acid is selected from the group consisting of dihomo-gamma-linolenic acid, arachidonic acid, adrenic acid, omega 6-docosapentaenoic acid, eicosatetraenoic acid, stearidonic

acid, eicosapentaenoic acid, omega 3-docosapentaenoic acid and docosahexaenoic acid, when said expressed desaturase of step (d) is a delta 12-desaturase.

39. A method of preventing or treating a condition caused by insufficient intake of at least one polyunsaturated fatty acid comprising administering to said patient said composition of claim 32 in an amount sufficient to effect said prevention or treatment.